

FACTORS WHICH INFLUENCE THE ACCURACY  
OF FLUID INTAKE AND OUTPUT

by

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## CHAPTER I

### INTRODUCTION

Approximately 60 per cent of the weight of a human being is water. Water is the largest single constituent of living cells; it is second in importance in the body only to oxygen. It is the medium in which all of the metabolic processes of life take place and is necessary for all vital processes in the body. Life itself depends upon a constant source and regulation of the amount of water in the body.

The regulation of this tissue fluid is one of the body's most important means of maintaining homeostasis of the internal environment upon which human survival depends. All of the body fluids contain electrolytes which control the chemical and physiological activity of the fluid. Fluid and electrolyte balance are interdependent. If one deviates from normal, so does the other. Normally, the chemical structure of body fluids helps maintain homeostasis of fluid distribution, and a fluid imbalance results if the chemical structure is altered. Therefore, for the purposes of this study, electrolytes will be referred to only when they influence the fluid balance of the patient.

The body is constantly adapting to variations in the availability of essential elements and to changes in body requirements. The individual's ability to survive depends on

this adaptation. Under normal circumstances body fluid and electrolytes are constantly being lost and must be replaced if normal processes are to continue. The healthy body easily maintains fluid and electrolyte balance if there is an adequate daily intake of food and liquids.

Nearly every medical and surgical condition threatens to upset this homeostatic mechanism and thus threaten fluid and electrolyte balance. If the mechanisms which normally regulate this balance are not functioning properly, the knowledge of the physician must supplement the wisdom of the body by supplying the body with the proper proportions of fluids and electrolytes needed to maintain and restore health. Effective fluid therapy demands that the volume and composition of abnormal losses or gains of fluids be determined and then replaced in the same amount and of essentially the same composition. Death may ensue if measures are not taken to restore the body's water and electrolyte balance.

Today the professional nurse is expected to assume some of the responsibilities formerly assumed by the physician. She is expected to give better, more intelligent nursing care through knowledge and application of scientific principles which underlie fluid and electrolyte metabolism. She is expected to have a greater knowledge about the functioning of the body and the deviations from normal. She must know the general principles governing fluid and electrolyte

balance, the portals by which water enters and leaves the body, the mechanisms that control the total volume of body water, and the mechanisms that regulate the distribution of water and electrolytes in the body. Through application of these principles and this knowledge, she will be a valuable member of the patient-care team in this increasingly important aspect of medical management of disease.

The only way a physician can adequately meet the fluid needs of a patient is by knowing his intake and fluid losses. An important nursing function is the careful observation and recording of fluid intake and fluid losses. When an imbalance threatens the health of a patient, fluid intake and output determinations are often the chief basis for accurate diagnosis and effective treatment.

By having a better understanding of the rationale underlying the medical plan of care, the informed nurse will find giving care to the patient more interesting and challenging; she will be able to interpret the patient's condition and behavior more intelligently and accurately.

## I. THE PROBLEM AND ITS IMPORTANCE

Whenever the fluid and electrolyte balance of a patient is threatened, or when accurate diagnosis and treatment of a patient depend upon information concerning fluid losses or gains, measurement of intake and output are ordered by the



physician. Careful measurement and accurate and comprehensive records, both of the kind and of the quantity of fluid going into and out of the patient, are of utmost importance.

According to the physicians with whom the writer has discussed the problem, and the literature on the subject, intake and output measuring and recording leave much to be desired. It has been said that nothing is more difficult to obtain in a modern hospital than an accurate twenty-four-hour urine output measurement and, unfortunately, this is often true.<sup>1</sup> One physician stated that he does not usually order measurement of intake and output because he knows that the information will be so incomplete or inaccurate that it will be worthless to him. Another stated that the procedure for intake and output measurement in his hospital is "lousy": the results are too scattered and are not accurately kept. Another doctor did an informal study on intake and output records in one hospital and concluded that the procedure was generally very inaccurate: this may be due to the critical nursing shortage and a lack of current knowledge of fluid and electrolyte balance by those who do the bedside nursing, and to the lack of interest of some of the doctors who manifested by their failure to discontinue orders for intake and output

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<sup>1</sup>Kathleen Newton Shafer, et al., Medical-Surgical Nursing (St. Louis: The C. V. Mosby Company, 1959), p. 68.

measurement when they were no longer necessary. Insufficient instruction of the selected patient who was to assist in measuring and recording his own intake and output was reported as another source of error. Thus, it was concluded by the study maker, that the physicians who were interviewed did not think intake and output recording was being accurately done.

However, this writer also interviewed nurses, both general staff nurses and those in supervisory positions, in each of the hospitals in Salt Lake City. Their opinion, with few exceptions, was that the method used for measuring and recording intake and output was satisfactory and that it was best not to try to make any changes.

The staff nurse has the responsibility of the twenty-four-hour supervision of the patient; therefore, it is important that each nurse know: (1) the common electrolytes in various body fluids and how they may be lost from the body in health and in disease, and (2) the amounts of body fluids and how they may be lost from the body. Thereby she can note and report early symptoms of imbalance and help prevent depletion of necessary substances.

The subject of fluid and electrolytes is relatively new, and the majority of the nurses who participated in this study indicated that they had little time devoted to this subject in their nursing courses. Fluid and electrolyte

balance is difficult to understand and to apply to nursing situations. Unless special emphasis is put on continued education, the nurse will not have the knowledge and understandings necessary to relate fluid and electrolyte balance to daily bedside nursing.

The purpose of this study was to determine whether nurses know the sources of potential fluid and electrolyte imbalance in relation to the importance of measuring and recording accurately fluid intake and output to aid the doctor in diagnosis and treatment of the patient.

Too, it was believed possible the questions posed in the questionnaire would stimulate the nurse to develop an interest in, and a desire to know more about fluids and electrolytes.

## II. LIMITATIONS

Beginning investigation into fluid and electrolyte balance included various members of the health team from the five hospitals in Salt Lake City.

The submission of the questionnaire was limited to the medical-surgical nurses in one hospital. These nurses had two, three, and four years of nursing education preparation. The kinds and lengths of nursing experience differed widely. Thus it could be expected that those who had had more education would have better knowledge about fluids and electrolytes.

Some of the nurses work in the thoracic and intensive care units and have had special preparation which included emphasis on fluids and electrolytes and so added a variable which was not controlled.

Another variable was the age of the nurses. Because of this some of the nurses received their education when fluid and electrolyte balance was not a part of the curriculum.

The conditions governing the completion of the questionnaire were not controlled. There was some indication that a few of the nurses used outside resources to obtain information.

This study was limited to the study of adults only and did not include children or infants. The bodily function of children is such that special consideration must be given to their fluid and electrolyte metabolism.

### III. DEFINITIONS OF TERMS USED

Water balance. Water balance is indicative of the constancy of the amount of water in the cells, outside the cells, and in the blood (vascular system). To maintain this equilibrium intake must equal output. Many of man's ills are related to water imbalance.

Electrolyte balance. Electrolyte balance is the balance maintained between the simple chemical constituents

of the normal body fluids. These chemical constituents are dissociated into ions which develop very small electrical charges when dissolved in water. Some ions develop a positive charge and are designated cations, while others give off a negative charge and are called anions. The number of cations always balances the anions in any given body fluid, and each body fluid has its own individual ionic composition.

Fluid balance. Water balance and electrolyte balance are interdependent so the term fluid balance was coined to encompass both of the concepts.

Homeostasis. Homeostasis is a term which refers to the state of constancy or stability that exists between the body fluids when there is a normal cation-anion ratio.

Parenteral therapy. The administration of therapeutic agents into the body other than by way of the alimentary tract is referred to as parenteral therapy.

## CHAPTER II

### REVIEW OF LITERATURE

Fifty years ago a countless number of deaths occurred due to the lack of knowledge about body fluids.<sup>1</sup> Only in the past fifteen years has the medical practitioner penetrated the surface of this complex and limitless aspect of medical science and been able to apply this new knowledge in the prevention and treatment of fluid imbalances.

There is a relative dearth of material regarding fluid balance as it applies to nursing. Only during the past five years has this subject been included in nursing textbooks and periodicals. Even so, the information included in these is insufficient to give the nurse the knowledge necessary to develop an understanding of the role of the electrolytes and fluid in body disturbances or the symptoms indicating imbalance.

One nursing study concluded that there was a significant difference in the ability of the surgical nurse to observe and identify correctly certain signs and symptoms of fluid imbalance when provided with a list of these symptoms, compared to her ability when not provided with a list. There

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<sup>1</sup>William Snively, Sea Within, The Story of Our Body Fluid (Philadelphia: J. B. Lippincott Company, 1960), p. 128.

was also a measurable difference in the number of actions actually taken by the nurse when a list of possible actions to be taken was provided, as compared to the actions taken when no list was provided. This study showed that a nurse who had pertinent information related to fluid balance pertaining to the patient who had gastro-intestinal surgery was able to play a more significant role in giving better nursing care than did the nurse who did not have this information.<sup>2</sup>

In order to convey this valuable information concerning fluid losses or gains of the patient to the physician, accurate measurement, both of the kind and quantity of fluids going into and out of the patient, and accurate recording of this measurement is of the utmost importance. If the nurse knows the basis for body fluid disturbances and the basis for their treatment, she cannot help but be convinced that accurate intake and output records are literally worth their weight in gold in many instances. There is usually no substitute for them.<sup>3</sup>

In order to know the importance of accurate intake and output measurement, the nurse must know how body water is

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<sup>2</sup>Carol Lee Walkingshaw, "Nurses Observations and Interventions Related to Fluid and Electrolyte Balance in Patients Having Had Gastro-intestinal Surgery" (unpublished Master's thesis, The University of Utah, Salt Lake City, 1963), pp. 27-28.

<sup>3</sup>Snively, op. cit., p. 128.

controlled and the most important constituents in body fluids that are affected by intake and output. The following is a summary of the physiology of body fluids and some of the conditions which affect fluid balance.

The cardinal principle of fluid balance is that intake must equal output. The average intake and output of a normal adult is about 2,500 ml of fluid daily.

The main source of body fluids is from ingestion of fluids and foods and from body metabolism. Thirst is the sensory impression that motivates the ingestion of water and is produced when the volume of body fluid is decreased. Thirst, however, may not necessarily be determined by a decrease in body fluids. Clinicians have noted that some edematous persons were thirsty and the dehydrated often were not. The absence of thirst did not mean that the patient had no need for fluids.<sup>4</sup> Disturbances in certain areas of the central nervous system, weakness, coma, and emotional factors upset this thirst mechanism; and it then becomes the responsibility of the nurse and the physician to insure adequate intake. Included among some of the most common errors found in a survey of the methods and results of fluid therapy in fifty small hospitals in some of the Midwestern states were:

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<sup>4</sup>Members of the Medical Staff, Lilly Research Laboratories, "Clinical Application of Fluid and Electrolyte Balance," Physician's Bulletin, 26:8, February, 1961.



(1) failure to provide enough free water for proper kidney function, and (2) the use of parenteral fluids where oral fluids would have accomplished the same purpose and more safely.<sup>5</sup> The nurse has been delegated to encourage the patient to consume an adequate amount of fluid daily and to keep a record of the amount of intake if there is any question of fluid imbalance.

The normal channels of exit of body water are in expired air from the lungs, in perspiration, urine and stools. In the normal individual, the loss from the stools and the gastrointestinal tract is negligible. In order to regulate body temperature by heat loss through evaporation, the average adult loses about 800 ml of fluid daily through the skin and lungs. Diaphoresis--profuse perspiration--is a potential source of fluid loss leading to dehydration and is difficult to measure except by a daily change in weight. Diaphoresis caused by fever greatly increases the patient's water requirements due to increased fluid loss from the lungs through expired air and from the skin through perspiration. As much as 500 ml of water may be lost daily for each degree of elevation of temperature.<sup>6</sup> The nurse must observe and record

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<sup>5</sup>Hollen W. Farr, "Fluid and Electrolyte Balance--With Special Reference to the Gastro-intestinal Tract," American Journal of Nursing, 54:826, July, 1954.

<sup>6</sup>Ibid., p. 829.

whether there is moderate or profuse diaphoresis when a careful check of fluid intake and output is considered necessary by the doctor and must encourage increased fluid intake when diaphoresis or fever are present. The nurse must also be aware that any great change in daily weight reflects a change in fluid volume, so it should be a nursing responsibility to obtain and record daily weights if there is any problem of fluid imbalance.<sup>7</sup>

A minimum of 500 ml of urine must be excreted from the kidneys daily or else uremia, a toxic condition in which waste products accumulate in the body, will develop and will lead to death if not corrected. Adjustments to intake are made primarily through changes in urine volume. Antidiuretic hormone (ADH), secreted by the hypothalamus and stored in the posterior pituitary, regulates renal output. If the intake of fluid is inadequate, the healthy kidney can compensate for this by excreting small amounts of concentrated urine, under the stimulus of ADH. If the patient is given or urged to drink more fluid than is required, and the homeostatis mechanisms are unimpaired, the kidney is able to excrete the excess. This ability to excrete excess fluid may be impaired by such disorders as cardiac failure, cirrhosis of the liver, kidney disease, or an acute disease of the

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<sup>7</sup>Ibid., p. 830.

central nervous system. Surgery, severe trauma, and stress, both physical and emotional, stimulates the production of ADH and tends to increase the amount of fluid retained by the body. If parenteral fluids are administered too rapidly in these conditions, or if renal function is limited, overloading, or water-logging of the tissues may result; thus the patient may drown in his own fluids.

. . . The mortality rate in anuria (the failure of the kidneys to secrete urine) is 46 per cent, death usually resulting from pulmonary and cerebral edema. In other words, treatment by forcing fluids in all cases is worse than the disease.<sup>8</sup>

Therefore, with the very young, the aged, the postoperative, the shocked, burned, cardiac or nephritic patient, fluids must be administered only in amounts lost by the body. It is a nursing responsibility to know whether the patient has an adequate urinary output and to report any significant reduction to the doctor. It is also a nursing responsibility to control the rate at which parenteral fluids are administered and to be aware of the conditions which affect this rate.

Sodium is an electrolyte which, to a large degree, controls the movement of water in the body and maintains normal fluid volume. It is derived from the ingestion of fluids and foods. Sodium resorption is controlled by aldosterone

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<sup>8</sup>Bertha Harmer and Virginia Henderson, Textbook of the Principles and Practice of Nursing (New York: The Macmillan Company, 1960), pp. 453, 741.

secreted by the adrenal cortex. When the cation-anion ratio is in balance excess sodium is excreted by the kidneys. A disruption of the homeostatic mechanism may lead to abnormal gains in sodium in the body which may result in systemic edema, or an excessive amount of fluid in the tissues, and will ultimately lead to pulmonary and cerebral edema and death if uncorrected. This is especially likely to develop in patients who have poor cardiovascular or renal function. Sodium containing foods and fluids are then limited or withheld and the underlying condition treated. Sodium depletion causes dehydration of the tissues and lowering of effective circulating blood volume. Sodium depletion is, with rare exceptions, caused by loss of sodium-containing fluid from the gastrointestinal tract or skin.<sup>9</sup>

Under normal conditions sodium loss from the skin is negligible. An increase in environmental temperature, fever, or muscular exercise may cause the patient to perspire excessively, resulting in a marked loss of sodium. A total day's intake of sodium may be lost in sweat in six to eight hours under adverse conditions.

The gastric juice has a high chloride and relatively low sodium content. There is a high sodium concentration in

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<sup>9</sup>Belding H. Scribner and James M. Burnell, Fluid and Electrolyte Balance (Seattle: University of Washington School of Medicine, 1963), p. 39.

the gastric mucus. Any condition which irritates the mucosa and causes vomiting also stimulates an increase in the production of mucus. Large amounts of chloride and sodium are lost in vomiting.<sup>10</sup> Lower intestinal fluids contain large amounts of sodium; repeated enemas, cathartics, diarrheal stool, colostomy, fistula, and ileostomy drainage contribute to sodium depletion.

Potassium, another electrolyte disturbed by fluid imbalance, affects cellular metabolism and muscle tonicity, and acts on the nerve cell. The largest amount of body potassium is found in the muscles and is regulated by the cells themselves. The body has no mechanism for conserving potassium so it must be replaced as it is lost. Potassium is obtained from foods and fluids and is excreted through the kidneys. Potassium depletion may be caused by inadequate intake, losses from gastrointestinal secretions, diarrheal stools, and stressful conditions such as surgery. Potassium depletion causes muscle weakness and will eventually cause heart standstill.

Elevated potassium levels render the muscles and nerve cells overactive and irritable which leads to heart block, respiratory paralysis, and death. Potassium excesses are

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<sup>10</sup>Abbott Laboratories, Fluids and Electrolytes  
(Chicago: Abbott Laboratories, 1960), pp. 18-20.

usually encountered when parenteral potassium is given too rapidly or when renal function is impaired; under normal conditions the body is able to excrete any excess taken by mouth. Elevated potassium levels are seen in patients who have severe burns, crushing injuries, or severe dehydration as potassium is released from the damaged cells into the plasma. Therefore, where renal function has been impaired or where there is muscle wasting or severe injury, potassium must be administered slowly and only after renal function has been re-established. Stored blood bank blood or blood that has been improperly refrigerated will be high in potassium levels and must be used cautiously in patients with impaired renal function.<sup>11</sup> It is a nursing responsibility to observe whether urinary output is adequate and to be sure that parenteral fluids which contain potassium are allowed to run in slowly when replacement therapy is used. The nurse must also be aware that some fluids, such as orange juice, tea, bouillon, and Coca Cola are high in potassium and must be given sparingly until renal function has been established.

In uncontrolled diabetes mellitus, hyperglycemia--excessive sugar in the blood--is a prominent finding. The amount of sugar present in the glomerular filtrate exceeds the resorptive capacity of the tubule cells. This increases

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<sup>11</sup>Scribner and Burnell, op. cit., pp. 72-83.

the osmotic pressure of the filtrate which in turn prevents the resorption of water from the filtrate, resulting in polyuria.

In diabetes, the oxidation of glucose is diminished. In order to obtain energy for cell work, fats are broken down by beta oxidation. This produces large amounts of acetates and acetic acid which cannot be burned to completion due to the lack of pyruvic acid, a product of glucose oxidation. The acetates and acetic acid accumulate in the blood and are converted to ketone bodies. These combine with sodium bicarbonate of the blood and deplete the sodium reserves resulting in acidosis.

Hyperventilation, another symptom of uncontrolled diabetes, is an attempt of the body to maintain acid-base balance. This is another source of fluid loss. Dehydration often results from uncontrolled diabetes, as does an electrolyte imbalance. The maintenance of an adequate, relatively constant urine output is important, as is the early replacement of fluids, sodium, and potassium.

In a severe burn, fluid and sodium are sequestered in the burn area during the initial phase, and there is a loss of potassium through the kidneys. This results in a loss of effective circulating blood and decreased fluid volume. The result is oliguria, a decrease in the secretion of urine. The fluid volume must be restored to increase the blood

volume and to support normal kidney function.

The second phase following burn damage begins about the third or fourth day and may last four to eight days. During this time there is a gradual reabsorption of these sequestered fluids and electrolytes. Adequate fluid must be provided for renal excretion of excess sodium and waste products from the burned area. During the first two stages, the amount of urinary output is the main guide to therapy.

The third phase, or period of rehabilitation, is a period of tissue catabolism resulting in a negative nitrogen balance and the loss of electrolytes. This period may last thirty days, and the adult patient may lose about one pound of body weight daily.<sup>12</sup>

There has been increasing attention given to the therapeutic effects of the cortico-steroids, and they are being employed in the treatment of a large number of diseases. Among the conditions commonly treated with cortisone, hydrocortisone, and adrenocorticotrophic hormone (ACTH) are the arthritic diseases, allergic diseases, and some lymphatic diseases. There are a number of serious adverse effects which may result from treatment with these agents, among which are sodium and water retention and a reduction of potassium

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<sup>12</sup>Donald E. Pickering, et al., Fluid and Electrolyte Therapy: A Unified Approach (Portland: The Medical Research Foundation, 1959), p. 77.



in the body. Unless well controlled, hypertension, pulmonary congestion, and death from cardiac failure may result from their use. The nurse must be aware of these complications and the need for salt restriction and diet adequate to replace potassium.<sup>13</sup>

The amount of fluid secreted by the gastrointestinal tract in twenty-four hours is close to 8,000 ml and is made up of salivary, gastric, hepatic, pancreatic, and intestinal mucosa secretions. Electrolytes are also present in large amounts in these secretions. The net loss from the body is negligible because these fluids and electrolytes are usually reabsorbed. The losses may be extremely large if there is vomiting, diarrheal stools, drainage from an enterostomy, a colostomy, a fistula, or gastric suction. When there is excessive vomiting or when gastric suction is being employed the patient should not be allowed to have ice chips and water because they stimulate gastric secretion and act as an effective "electrolyte pump": there is a rapid release of electrolytes into water admitted into the stomach and the intestine. The resulting solution is then suctioned out, or vomited. There must be an accurate accounting of fluids used for irrigating gastric suction tubes and the amount of

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<sup>13</sup>Charles H. Best and Norman B. Taylor, The Physiological Basis of Medical Practice (Baltimore: The Williams and Wilkins Company, 1961), pp. 1036-42.

drainage obtained from the suction to allow for accurate replacement therapy.<sup>14</sup>

Wound drainage is a potential source of fluid and electrolyte loss and must be measured whenever fluid balance is threatened. Weighing of the dressings before they are applied to the wound, and then again after they are removed from the wound is one of the simplest methods of determining wound drainage.<sup>15</sup>

From the review of literature it was concluded that there has been a vast increase in the amount of knowledge about fluids and electrolytes and its application in the treatment and prevention of bodily disorders. Nursing has not kept pace with research in the area of fluids and electrolytes and with the clinical application of these findings. Currently more attention is being given this topic in nursing journals and nursing textbooks. It is the opinion of the writer that there still is a lack of simply stated, useful, technical information for nurses which would help them to develop an understanding of the necessity for keeping an accurate intake and output record.

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<sup>14</sup>Pickering, et al., op. cit., p. 44.

<sup>15</sup>Scribner and Burnell, op. cit., p. 114.

## CHAPTER III

### METHOD

At the beginning of this study it was the opinion and observation of the writer that intake and output measurements and records were not accurate. In order to get the opinion of other persons concerned with fluid balance, various doctors and nurses from each of the hospitals in Salt Lake City were interviewed. The doctors and nurses differed sharply in their thinking as to the adequacy of fluid balance measurements and records; the physicians unanimously agreed that fluid balance measurements as related to the responsibilities of the nurse were inadequate and poorly done. With few exceptions, the nursing group, which included supervisors, head nurses, and inservice educational directors, expressed the belief that intake and output measurement and recording were being done as well as could be expected.

This divergence of thinking led to a serious consideration of the following question: Do nurses possess the knowledge necessary to accurately measure and record intake and output? In order to answer this question, a questionnaire was developed which covered the aspects of fluid intake and output and the electrolytes most vital to fluid balance.

Instrument used in the study. To answer the question of whether nurses possess the knowledge necessary to accurately measure and record fluid intake and output, it was necessary for the investigator to construct and develop a suitable tool. It was thought that if the nurses could answer the following questions correctly they would have the necessary knowledge to carry out nursing responsibilities related to fluid balance.

1. In what manner are fluids and electrolytes normally gained and lost by the body?
2. What factors are indicative of fluid homeostasis?
3. What conditions upset the normal fluid balance of the body?
4. How do these conditions disturb the water balance of the body?

Using the information gained from nursing journals, nursing textbooks, medical books, and discussions with physicians, a questionnaire was developed. Thirty questions were included and these were divided into three sections. Section I consisted of ten multiple choice items. Section II was made up of ten yes or no statements, and Section III consisted of ten completion questions.

Questions 1, 3, and 10 of Section I and Questions 1 and 6 of Section III were designed to test the nurse's knowledge of the manner in which fluids and electrolytes are

normally gained and lost by the body.

Questions 6 and 7 of Section I, Questions 5, 9, and 10 of Section II, and Questions 8-a, 8-b, and 8-c of Section III were considered pertinent to the factors indicative of fluid homeostasis.

Questions 2 and 8 of Section I, Questions 3 and 4 of Section II, and Questions 2, 3, and 7 of Section III were planned to bring out points relative to the conditions which disturb the normal fluid balance of the body.

Questions 4, 5, and 9 of Section I; Questions 1, 2, 6, 7, and 8 of Section II; and Questions 4 and 5 of Section III were included to learn whether the nurse knew how these conditions disturb the water balance of the body.

To validate the importance of each question, the questionnaire was submitted to various doctors as a committee of experts. This committee of experts consisted of three internists, two surgeons, two urologists, three pediatricians (chosen because of their special knowledge of fluid balance), one specialist in gastrointestinal conditions, and one doctor who is active in teaching and research. Eight of the twelve experts responded with suggestions and opinions as to the validity of each of the items. Only one of the eight doctors who responded indicated that he believed that to some degree it seemed a little on the difficult side for the "nursing level of medicine." The questionnaire was also

submitted to instructors of medical-surgical nursing for their appraisal. The tool was then revised to incorporate the suggestions made by both groups.

The first page of the instrument consisted of instructions for the completion of the questionnaire. It also requested the following data: age, kind of program from which graduated, and how much time in the program was devoted to the topic of fluid and electrolytes.

Plan for the collection of data. Permission was gained from the director of nursing of a general hospital to submit the questionnaire, which was to take approximately thirty minutes to complete, to all of the staff nurses employed in the medical-surgical nursing areas. This general hospital had a patient census of approximately 450 patients. About 350 of these were classified as medical-surgical patients.

The director of nursing made arrangements with the head nurses to distribute the questionnaire to the nurses on their divisions. Ninety-five nurses received the questionnaire. The staff nurse was to complete the questionnaire at her own convenience. The completed questionnaire was to be returned to the head nurse on each division. The writer collected the completed questionnaires from the head nurses.

Statistical method. Fifty of the ninety-five nurses returned their completed questionnaires. The data on the questionnaires was analyzed to gain the following information: (1) the total number of nurses in each age group; and (2) the total number of nurses with each different type of basic nursing preparation. Each questionnaire was scored to learn the number of questions each respondent answered correctly. No correction was made for guessing. Each question was given equal weight since it was the opinion of the experts that each question was vital.

The total number correct was tabulated according to age category and according to the amount of nursing education received.

The mean and standard deviation were next determined and letter grades assigned to each nurse on the basis of the following:

- A = above 1.5 standard deviations
- B = +0.5 to +1.5 standard deviations
- C = -0.5 to +0.5 standard deviations
- D = -0.5 to -1.5 standard deviations
- E = below -1.5 standard deviations.

A frequency table was made to determine the number of nurses who received each letter grade. Following this, the number of nurses who received each letter grade was placed in

one table according to the number of years of educational preparation, and in another table according to the age group.

The average score was then determined for each age category and for the type of educational program. This was done to determine whether there was any relationship between the age and the average score, or between the type of educational program and the average score. Each grade was given the following points: A = 4, B = 3, C = 2, D = 1, E = 0.

Chi-square was computed to determine the statistical relationship between the type of educational program and the grade received. Chi-square was also computed to determine the statistical relationship between the age of the participants and the grade received.

The items in the tool were placed in categories according to the question they would answer. It was then determined what percentage of the participants answered how many of the questions correctly.

Finally, an item analysis was done to determine which of the items were answered correctly by the majority of the nurses, and which were answered incorrectly by the largest number of nurses.



## CHAPTER IV

### FINDINGS AND CONCLUSIONS

This chapter presents the findings of the performance on the questionnaire of the sample group of medical-surgical nurses concerning fluid balance, and the conclusions reached. The scores on the questionnaires were tabulated and the data were studied to find whether there was any relationship between the knowledge of fluid balance and the various age groups, or to the length of the educational program.

The questionnaires were distributed to ninety-five nurses; fifty of them were returned, which represented a 53 per cent return.

The mean and standard deviation were computed and found to be:  $M = 17.3$ ,  $S.D. = 4.5$ . A frequency table was set up and letter grades were assigned according to standard deviation.

As shown in Table I, 34 per cent of the participants received grades of A and B and presumably possessed the necessary knowledge relative to fluid balance to measure and record fluid intake and output accurately. Forty-two per cent of the nurses sampled received a grade of C and might be expected, on the basis of their knowledge of fluid and electrolytes, to do an average job of measuring and recording intake and output. Twelve of participants, or 24 per cent of

TABLE I

FREQUENCY AND PER CENT OF PARTICIPANTS GETTING VARIOUS  
NUMBER OF ITEMS CORRECT, THE GRADE,  
AND STANDARD DEVIATION

Number Correct	Frequency	Per Cent of Participants	Grade	Standard Deviation
25	3	6	A	Above +1.5
24	1			
23	2			
22	3	28	B	+ .5 to +1.5
21	6			
20	2			
19	4			
18	4			
17	4	42	C	- .5 to + .5
16	7			
15	2			
14	2			
13	4	12	D	- .5 to -1.5
12				
11				
10	3			
9				
8	2	12	E	Below -1.5
7	1			

the sample, fell in the D and E grade levels. Therefore, approximately one-fourth of the participants did not have the knowledge necessary to enable them to measure and record intake and output accurately.

It is the aim of nursing to give good, intelligent nursing care based upon knowledge and understanding of the facts and principles of fluid balance. According to the results of the questionnaire, 66 per cent, or approximately two-thirds of the nurses in the sample, were not prepared to function in this manner.

The largest number of medical-surgical nurses was represented by the 21 to 30 age group. The small number (2) in the 61 to 70 age group was too small a sampling to be reliable. It was to be anticipated that the 21 to 30 age group would have more knowledge of fluid balance since this subject has been included only recently in nursing school curriculums. This was found to be true with the exception of the 51 to 60 age group, which, as shown in Table II, had an average score of 2.37, compared to 2.2 of the youngest age group. The following explanation may account for this exception. Many of the nurses in the two oldest age groups worked on the thoracic surgery unit where they had had special preparation for this kind of nursing, and on this area fluid and electrolyte balance was stressed as being very important to the life of the patient having thoracic surgery.

TABLE II  
AGE CATEGORY, NUMBER AND PER CENT OF PARTICIPANTS, AND  
AVERAGE SCORE

Age	Number of Participants	Number of Participants	Average Score
21-30	22	44	2.2
31-40	11	22	1.8
41-50	7	14	1.4
51-60	8	16	2.4
61-70	2	4	2.0

Chi-square for the age groupings of the nurses and the scores made on the questionnaire was 2.3, df-4. This was not significant at the .05 level of probability. The table justifying this is found in Appendix B. Thus, statistically, the findings of this small sample did not support the supposition that age makes a difference in the amount of knowledge the medical-surgical nurse possesses concerning fluid and electrolyte balance.

As shown by Table III, there appeared to be a relationship between the years of nursing education and how well the participants were able to respond on the questionnaire. Those nurses who graduated from a four-year basic nursing program had a higher average score than those who graduated

from a two or three-year program. This could be expected as the four-year baccalaureate degree program accentuates an understanding of theory and principles as basic to giving good nursing care, whereas the two and three-year programs emphasize the technical aspects of bedside nursing. Statistically there was no significance when the years of education and grades received were compared by using chi-square. The chi-square was 2.4, df-2. The table showing this is found in Appendix B.

TABLE III

YEARS OF NURSING EDUCATION, NUMBER AND PER CENT OF NURSES,  
AND AVERAGE SCORE

Years of Education	Number of Nurses	Per Cent	Average Score
2	7	14	1.85
3	28	56	1.85
4	15	30	2.46

It was found that those nurses who were in the age range from 21 to 30 and had graduated from a four-year nursing program had the highest average score. Shown in Table IV, the next highest score was found to be made up of those three-year graduates in the 51 to 60 age group; the probable reasons for this group having achieved such a score

were discussed earlier (see page 30). The lowest average score was found in the 31 to 40 age group who graduated from the diploma program, a three-year program.

TABLE IV  
RELATIONSHIP BETWEEN AGE, YEARS OF NURSING EDUCATION,  
AND AVERAGE SCORE

Age and Preparation	Number	Average Score
21-30		
2 yr.	7	1.9
3 yr.	6	2.0
4 yr.	9	2.6
31-40		
2 yr.	0	
3 yr.	5	1.2
4 yr.	6	2.3
41-50		
2 yr.	0	
3 yr.	7	1.4
4 yr.	0	
51-60		
2 yr.	0	
3 yr.	8	2.4
4 yr.	0	
61-70		
2 yr.	0	
3 yr.	2	2.0
4 yr.	0	

The findings of this study may be such that generalizations may not be made because there was no representation from the two-year associate degree program except in the 21 to 30

age group. Also, there were no four-year graduates represented in the 41 to 50, 51 to 60, and 61 to 70 age groups.

Prior to the administration of the questionnaire, an analysis was done of each question to determine under which of the four areas of water and electrolyte balance it should be categorized. These areas were: (1) the manner in which fluid and electrolytes are normally gained and lost by the body; (2) factors which are indicative of fluid homeostasis; (3) conditions which upset the normal fluid balance of the body; and (4) the manner in which these conditions upset the water balance of the body. Table V shows that Category I, which included five questions relative to knowledge of approximate measures of body fluids, had the lowest number of correct responses. Only 34 per cent of the respondents answered three or more of the questions dealing with this category correctly. None of the respondents answered all of the questions correctly, and 8 per cent were unable to give the correct answer to any of the questions. This is a relatively important area because the nurse cannot be expected to have a knowledge of fluid balance and obtain an accurate intake and output if she does not know the amounts of fluids normally gained and lost by the body, and the amounts necessary for maintaining body function.

Category II included eight items; 70 per cent of the respondents answered half or more of the questions correctly,

TABLE V

NUMBER AND PER CENT OF NURSES GETTING VARIOUS NUMBER  
OF ITEMS CORRECT IN THE FOUR CATEGORIES

Category	Number of Correct Responses	Number of Nurses	Per Cent of Nurses
I	0	4	8
	1	14	28
	2	15	30
	3	11	22
	4	6	12
	5	0	0
II	0	1	2
	1	2	4
	2	1	2
	3	5	10
	4	6	12
	5	14	28
	6	15	30
	7	4	8
III	8	2	4
	0	0	0
	1	2	4
	2	2	4
	3	11	22
	4	21	42
	5	10	20
	6	4	8
IV	7	0	0
	0	0	0
	1	0	0
	2	1	2
	3	4	8
	4	3	6
	5	10	20
	6	6	12
	7	11	22
	8	7	14
	9	5	10
	10	3	6



thus indicating the majority of the nurses sampled knew the principles of fluid homeostasis. Two respondents answered all of the questions correctly, and one missed all of the items.

There were seven questions in Category III; 70 per cent of the respondents answered four or more of the questions correctly. None of the nurses answered all of the questions correctly, but none of them missed all of the questions.

Of the ten questions in Category IV, 64 per cent of the nurses answered half or more of the questions correctly, indicating that many of them knew how certain medical and surgical conditions upset the water balance of the body. Three answered all ten items correctly, and all respondents answered two or more of the questions correctly.

## CHAPTER V

### SUMMARY

Fluid and electrolyte balance is one of the most important processes in the body upon which life itself depends. Nearly every medical and surgical condition threatens to upset this balance. It is the responsibility of the physician to supply fluids when the mechanisms which normally regulate homeostasis are not functioning properly.

The professional nurse is expected to give better, more intelligent nursing care through knowledge and application of scientific principles which underlie fluid and electrolyte metabolism. Only by knowing these principles about water balance, the portals by which fluids leave the body, and the mechanisms that control the volume and distribution of fluid in the body can she realize and appreciate how important it is to supply the physician with accurate and comprehensive records of all fluids that are taken in or lost from the body.

Nursing has not kept pace with the advances medical science has made recently relative to the body ills due to imbalances of body fluids. Nurses need to become more aware of the principles basic to an understanding of fluid and electrolyte balance and to apply these principles as they give nursing care to patients.

From the review of literature and according to the physicians with whom the writer has discussed the problem, it was concluded that it is difficult to obtain an accurate fluid intake and output record. In discussing the problem with nurses, however, the majority of nurses were of the opinion that intake and output measurement and records were done as well as possible.

This study was an attempt to determine whether nurses did possess the knowledge necessary to obtain an accurate intake and output record. A questionnaire was devised composed of questions that a committee made up of physicians and nursing educators thought were necessary for the nurse to know if she were to be able to give intelligent nursing care as related to fluid balance.

This questionnaire was completed by fifty nurses who care for medical-surgical patients. The findings from this questionnaire showed that 34 per cent of the respondents did possess the knowledge necessary to give good nursing care relative to fluid balance; that 42 per cent might give adequate nursing care, and that 24 per cent did not possess the knowledge necessary to enable them to measure and record intake and output accurately.

Statistically there appeared to be no significant relationship between the type of basic nursing education program from which the participants graduated and the average score

they made. Those nurses who received a baccalaureate degree from a four-year school of nursing did better than those who graduated from a two or three-year program. The highest average score was achieved by the 21 to 30 age group who had four years of nursing education.

There was not an adequate representation of all types of nursing education in all age groups, thus the researcher was unable to draw any definite conclusions.

A larger sampling with the use of an improved tool may substantiate the conclusion of this writer that more information about fluid balance must be included in the curriculum of schools of nursing and that those nurses who have already graduated must be informed of these new advances in nursing through continued education and inservice programs.

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## APPENDIX A

## QUESTIONNAIRE

This study is part of a master's thesis and its purpose is to find the areas of weakness in relation to body fluids and electrolytes as related to intake and output. The study is concerned with the fluid balance of adults only.

Please answer the questions without help from anyone. This is to determine your general knowledge, and any outside help will invalidate the study. If you do not know the answer to any questions, please DO NOT GUESS.

Do not put your name on the test. After you have finished answering the questions put them back in the envelope, seal the envelope, erase your name from the envelope, and leave it with the nurse in charge of your unit.

Thank you for your help.

CHECK THE FOLLOWING WHICH APPLY TO YOU:

Age: ☐ 21-30

☐ 31-40

☐ 41-50

☐ 51-60

☐ 61-70

Kind of program from which graduated:

☐ 2-year associate degree program

☐ 3-year diploma program

☐ 4-year baccalaureate degree program

How much time in your program was devoted to fluids and electrolytes?

☐ None

☐ Some

☐ Very little

☐ Quite a bit

## SECTION I

Underline the word or number which makes the statement correct.

1. The kidneys need to excrete at least (200, 500, 800 ml.) of water during a 24-hour period, regardless of intake, or else body wastes will accumulate and cause uremia.
2. The intake of fluids should be (increased, decreased) in acute renal failure.
3. The amount of fluid secreted into the gastrointestinal tract in 24 hours is approximately (1,200; 4,000; 8,000) cc.
4. Glucosuria (increases, decreases) the patient's fluid requirements.
5. Immediately after a severe burn, plasma collects in the burn area; this results in an (increase, decrease) of urinary output.
6. Approximately (30, 60, 90 per cent) of the body weight is water.
7. The concentration of urine is normally regulated by ADH (antidiuretic hormone) released by the posterior pituitary. The action of ADH (increases, decreases) urinary output.
8. After surgery and severe injuries the secretion of ADH is increased; therefore, in the early post-traumatic and post-operative periods, the amount of fluids administered must be (equal to, less than, greater than) the amounts lost by the body.
9. For every degree of elevation of temperature, the patient loses about (100, 300, 500) cc. of fluid in 24 hours.
10. The insensible water loss, from skin and lungs, is approximately (250, 500, 750) cc. in a 24-hour period.

## SECTION II

The statements given below may be answered by yes or no. If the statement is correct, place the word yes in the blank in front of the statement. If the statement is incorrect, place the word no in the blank in front of the statement.

- \_\_\_\_\_ 1. Postassium-containing fluids may be given to the patient having poor renal function.
- \_\_\_\_\_ 2. Solu B should not be given to the patient having poor renal function.
- \_\_\_\_\_ 3. Acute renal failure is the failure of the kidneys to excrete urine.
- \_\_\_\_\_ 4. The failure to drink is the most common cause of dehydration.
- \_\_\_\_\_ 5. Adjustments of output to intake of water in the body are accomplished chiefly by changes in the urine volume.
- \_\_\_\_\_ 6. It is desirable for a patient on gastric suction to have ice chips.
- \_\_\_\_\_ 7. Heart block is a frequent complication of the rapid administration of potassium-containing fluid.
- \_\_\_\_\_ 8. The administration of excessive amounts of fluid may result in pulmonary edema.
- \_\_\_\_\_ 9. The fluid balance of a patient is best determined by weighing the patient.
- \_\_\_\_\_ 10. The rate at which fluids are lost from the body determines the rate at which they should be replaced.

## SECTION III

Place the word which makes the statement true in the blank space provided. If there is more than one blank, this necessitates one word in each blank.

1. The \_\_\_\_\_ are known as the principal organs which regulate water balance.

2. \_\_\_\_\_ is the chief electrolyte lost in gastric suction or excessive vomiting.
3. \_\_\_\_\_ is the chief electrolyte lost in diarrheal stools.
4. \_\_\_\_\_ is one of the clear fluids included in the patient's diet which may foster the retention of body water.
5. \_\_\_\_\_ is one of the clear fluids included in the patient's diet which may promote the excretion of body water.
6. \_\_\_\_\_ normally regulates the ingestion of water.
7. \_\_\_\_\_ may be caused by excessive use of diuretics, inadequate intake, loss of fluid from a colostomy.
8. \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ are the three principal electrolytes of body fluids.

## APPENDIX B

TABLE VI

RELATIONSHIP BETWEEN AGE OF PARTICIPANTS AND PER CENT  
OF QUESTIONS CORRECT

Per Cent	Age				
	21-30	31-40	41-50	51-60	61-70
50-100	17	7	4	6	2
0-50	5	4	3	2	0

TABLE VII

RELATIONSHIP OF THE TYPE OF PROGRAM FROM WHICH PARTICIPANTS  
GRADUATED AND PER CENT OF QUESTIONS CORRECT

Per Cent	Type of Program		
	2-year	3-year	4-year
50-100	5	18	13
0-50	2	10	2